

# SAGE III ISS Utilization of Disturbance Monitoring Package

in Data Products
SAGE III/ISS Science Team Meeting at NASA LaRC

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13 October 2022



# Utilization of DMP in Data Products Charles Hill

#### DMP Overview

What is it?
Where is it?
Daily Observations

### 1141131111331311

#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

#### Species

O<sub>3</sub> NO<sub>2</sub> H<sub>2</sub>O

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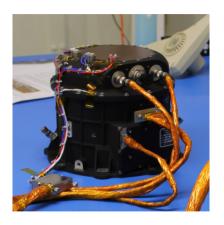
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# **Disturbance Monitoring Package (DMP)**





- ► The DMP is a Honeywell Miniature Inertial Measurement Unit comprised of three orthogonal ring laser gyros to measure angular rates in three orthogonal axes.
- ► The SAGE III science retrieval algorithm requires precise pointing knowledge with respect to Earth and the radiant target.
- ► The DMP's primary requirement was to flag periods when vibration conditions can negatively impact the science data product.

### Utilization of DMP in Data Products Charles Hill

DMP Overview What is it?

## **SAGE III ISS** Sensor

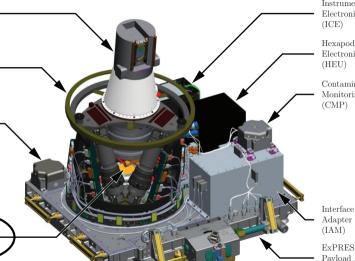




Assembly

Contamination Monitoring Package (CMP)

> Disturbance Monitoring Package (DMP)



Instrument Control Electronics (ICE)

Hexapod Electronics Unit (HEU)

Contamination Monitoring Package (CMP)

Adapter Module

Payload Adapter (ExPA)

(IAM)

Express

Utilization of DMP

in Data Products

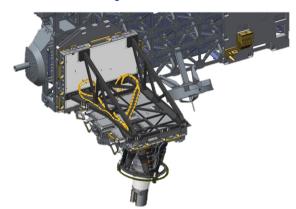
Charles Hill

DMP Overview

Where is it?



## **Payload Overview**



The Stratospheric Aerosol and Gas Experiment (SAGE) III is an external payload on the International Space Station (ISS) launched on SpaceX CRS-10 on 19 February 2017 and robotically installed on ExPRESS Logistics Carrier-4 (ELC-4). First light was acquired on 17 March 2017.



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DMP Overview

What is it? Where is it?

Daily Observations

Transmission

#### Aerosol Products

384 nm Aeroso 676 nm Aeroso 756 nm Aeroso 1021 nm Aeros

#### Species

0<sub>3</sub> NO<sub>2</sub> H<sub>2</sub>O

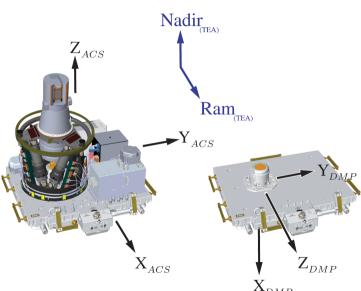
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# **Payload Axes**





### Utilization of DMP in Data Products

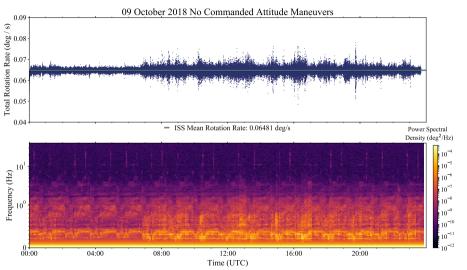
#### DMP Overview

Where is it?



## Quiescent Day as Observed from ELC-4





Utilization of DMP in Data Products Charles Hill

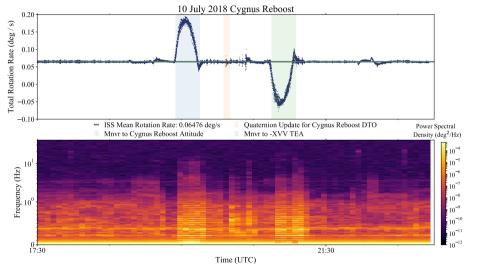
DMP Overview

Daily Observations



## Large Shock from Reboost Observed from ELC-4







DMP Overview

Where is it?

Daily Observations

How are we using it?

Transmission

### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol 1021 nm Aerosol

### Species

O<sub>3</sub> NO<sub>2</sub> H<sub>2</sub>O

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# **SAGE III Boresight Coordinates**

 $\hat{\omega}_{X,ELEV}$ 

scan head







### DMP Overview

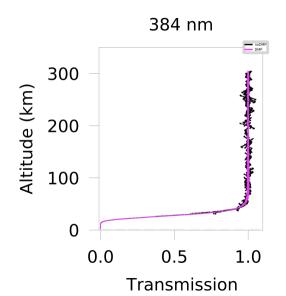
How are we using it?





# **Elevation Correction Improves Transmission Noise**



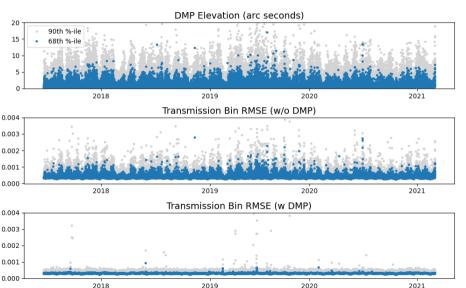


Utilization of DMP in Data Products Charles Hill DMP Overview Transmission



# **Elevation Correction Improves Transmission Noise**





Utilization of DMP in Data Products Charles Hill

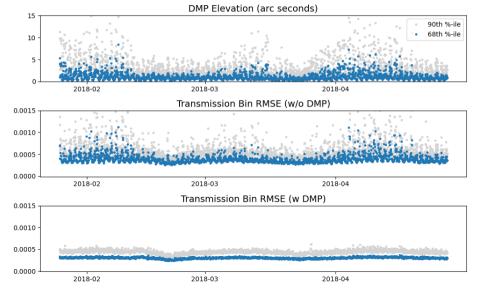
DMP Overview

Transmission



# **Elevation Correction Improves Transmission Noise**





Utilization of DMP in Data Products

Charles Hill

DMP Overview

What is it? Where is it? Daily Observations How are we using it?

Transmission

### Aerosol Products

84 nm Aerosol 76 nm Aerosol 56 nm Aerosol 021 nm Aerosol

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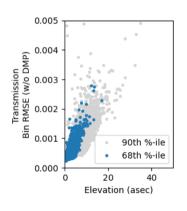
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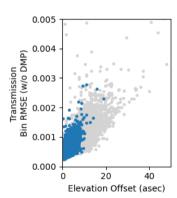


### **Correlation With Elevation Vibration**









# Utilization of DMP in Data Products

Charles Hill

### DMP Overview

What is it?
Where is it?
Daily Observations
How are we using it?

### Transmission

#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol 1021 nm Aeros

#### Species

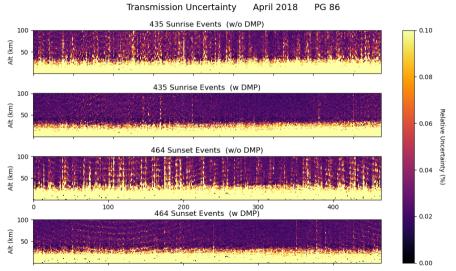
 $O_3$  $NO_2$  $H_2O$ 

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# Utilization of DMP in Data Products Charles Hill

### DMP Overview

What is it?
Where is it?
Daily Observations

### Transmission

#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol 1021 nm Aerosol

### Species

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Products Summa

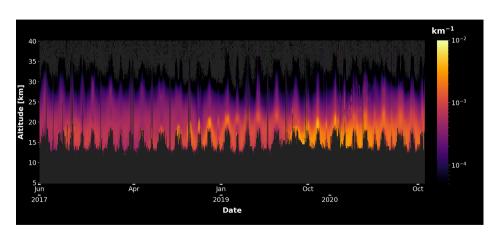
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### 384 nm Aerosol NO DMP Correction





# Utilization of DMP in Data Products

DMP Overview
What is it?

Daily Observations

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#### Transmission

#### Aerosol Products

384 nm Aerosol 676 nm Aerosol

1021 nm Aerosol

### Species

O<sub>3</sub> NO<sub>2</sub> H₂O

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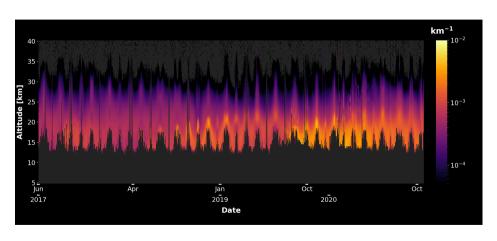
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## 384 nm Aerosol With DMP Correction





### Utilization of DMP in Data Products

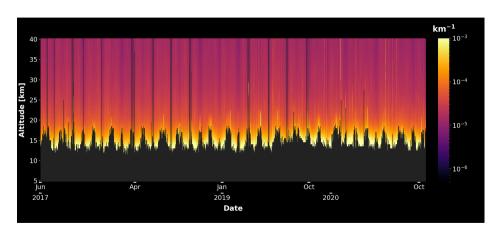
DMP Overview

384 nm Aerosol



# 384 nm Aerosol Uncertainty NO DMP Correction





# Utilization of DMP in Data Products

# DMP Overview What is it?

Where is it?

Daily Observations

How are we using it?

#### Transmission

### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

### Species

O<sub>3</sub> NO<sub>2</sub> Н<sub>2</sub>О

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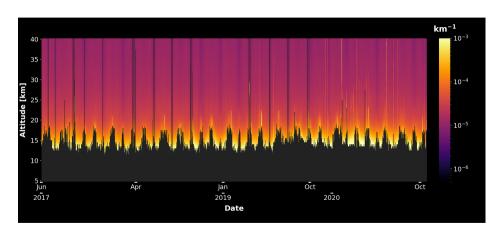
What is next

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# 384 nm Aerosol Uncertainty With DMP Correction





Utilization of DMP in Data Products

Charles Hill

DMP Overview

Where is it? Daily Observations

Transmission

### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

### Species

 $O_3$   $NO_2$   $H_2O$ 

Products Sumn

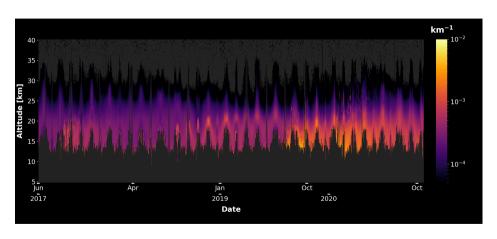
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### 676 nm Aerosol NO DMP Correction





### Utilization of DMP in Data Products Charles Hill

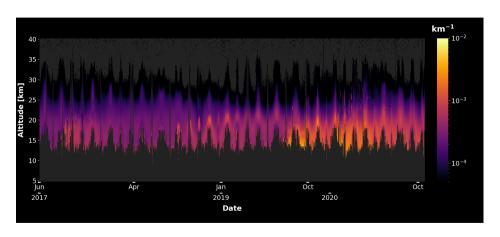
DMP Overview

676 nm Aerosol



## 676 nm Aerosol With DMP Correction





# Utilization of DMP in Data Products Charles Hill

### DMP Overview

What is it?
Where is it?
Daily Observations

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#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

### Species

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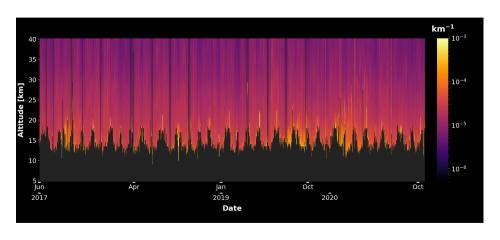
What is next

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# 676 nm Aerosol Uncertainty NO DMP Correction





# Utilization of DMP in Data Products Charles Hill

# DMP Overview What is it?

Where is it?

#### Transmission

### Aerosol Products

676 nm Aerosol 756 nm Aerosol

### Species

 $O_3$   $NO_2$   $H_2O$ 

Products Sumi

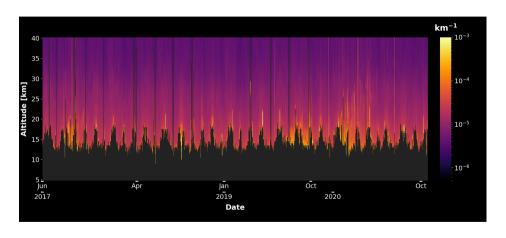
What is next?

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# 676 nm Aerosol Uncertainty With DMP Correction





# Utilization of DMP in Data Products Charles Hill

DMP Overview
What is it?
Where is it?

How are we using it

#### Transmission

### Aerosol Products

676 nm Aerosol 756 nm Aerosol

### Species

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m O_3}$   ${
m NO_2}$   ${
m H_2O}$ 

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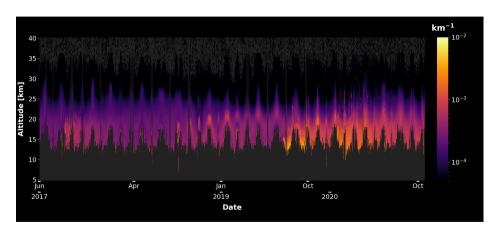
What is next

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### 756 nm Aerosol NO DMP Correction





# Utilization of DMP in Data Products

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DMP Overview

Where is it? Daily Observations

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#### Transmission

#### Aerosol Products

384 nm Aerosol 676 nm Aerosol

756 nm Aerosol

### Species

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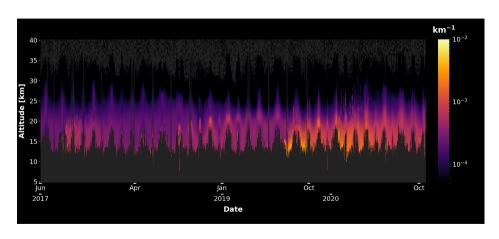
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## 756 nm Aerosol With DMP Correction





# Utilization of DMP in Data Products

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DMP Overview

Where is it?

How are we using

Transmission

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384 nm Aerosol

756 nm Aerosol

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H<sub>2</sub>O

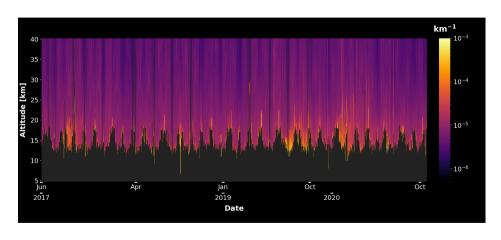
What is next

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# 756 nm Aerosol Uncertainty NO DMP Correction





### Utilization of DMP in Data Products Charles Hill

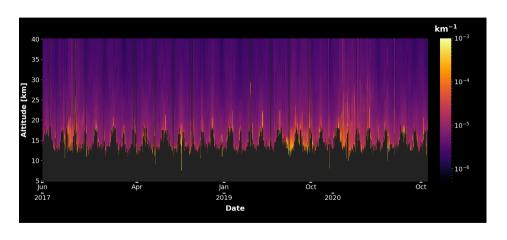
DMP Overview

756 nm Aerosol



# 756 nm Aerosol Uncertainty With DMP Correction





# Utilization of DMP in Data Products Charles Hill

### Where is it? Daily Observations

DMP Overview

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### Aerosol Products

676 nm Aerosol 756 nm Aerosol

### Species

 $O_3$   $NO_2$   $H_2O$ 

H<sub>2</sub>O Products S

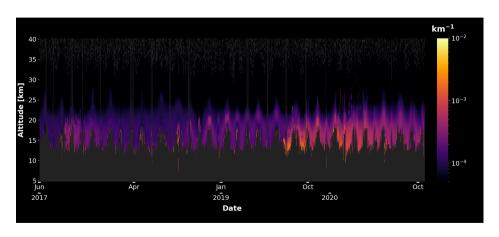
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## 1021 nm Aerosol NO DMP Correction





# Utilization of DMP in Data Products

### DMP Overview

What is it? Where is it? Daily Observations

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#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

#### Species

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Products Sumn

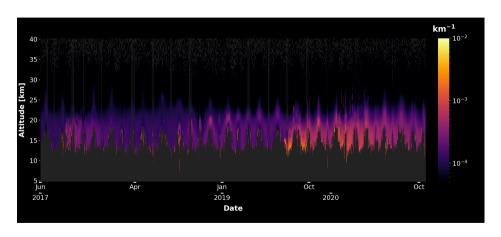
What is next

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## 1021 nm Aerosol With DMP Correction





# Utilization of DMP in Data Products

### DMP Overview

What is it? Where is it? Daily Observations

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#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

#### Species

0<sub>3</sub> NO<sub>2</sub> H<sub>2</sub>O

Products Sumn

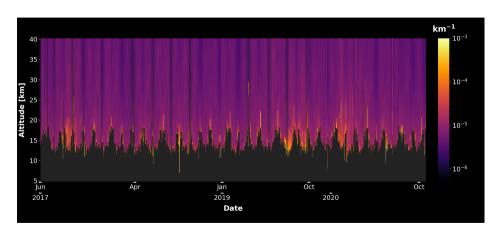
What is next

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## 1021 nm Aerosol Uncertainty NO DMP Correction





# Utilization of DMP in Data Products Charles Hill

### Daily Observations

DMP Overview

Transmission

### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol 1021 nm Aerosol

### Species

O<sub>3</sub> NO<sub>2</sub> Н<sub>2</sub>О

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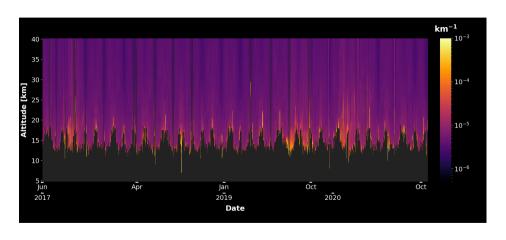
What is next?

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# 1021 nm Aerosol Uncertainty With DMP Correction





# Utilization of DMP in Data Products Charles Hill

#### Where is it? Daily Observations

DMP Overview

Transmission

#### Transmission

### Aerosol Products

676 nm Aerosol 756 nm Aerosol 1021 nm Aerosol

### Species

 ${
m O_3}$  ${
m NO_2}$  ${
m H_2O}$ 

H<sub>2</sub>O Products 5

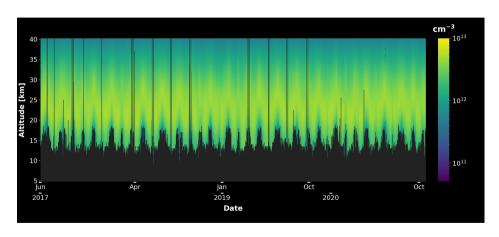
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## O<sub>3</sub> Product NO DMP Correction





# Utilization of DMP in Data Products Charles Hill

### DMP Overview

Where is it?

Daily Observations

#### Transmission

#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

#### Species

NO<sub>2</sub> H<sub>2</sub>O

Products Sun

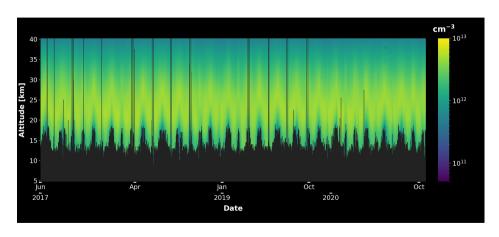
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## O<sub>3</sub> Product With DMP Correction





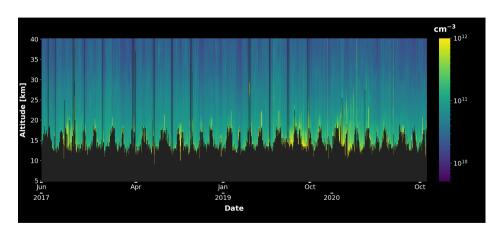
### Utilization of DMP in Data Products Charles Hill

### DMP Overview



# O<sub>3</sub> Uncertainty NO DMP Correction







### DMP Overview

Where is it?

Daily Observations

#### Transmission

#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

#### Species

**O<sub>3</sub>** NO<sub>2</sub> H<sub>2</sub>O

Products Sum

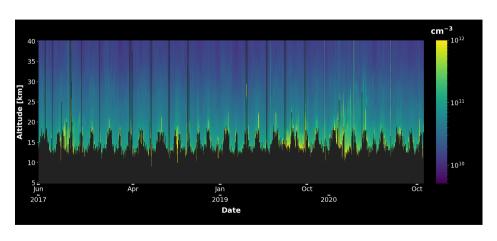
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# O<sub>3</sub> Uncertainty With DMP Correction





# Utilization of DMP in Data Products Charles Hill

## DMP Overview

Where is it?
Daily Observations

#### Transmission

#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

#### Species

**O<sub>3</sub>** NO<sub>2</sub> H<sub>2</sub>O

Products Summ

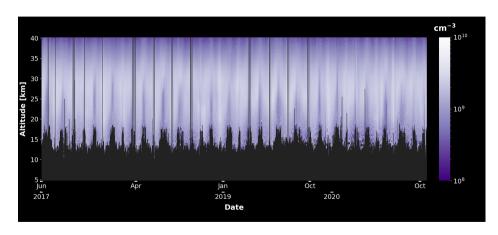
What is next

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## NO<sub>2</sub> Product NO DMP Correction





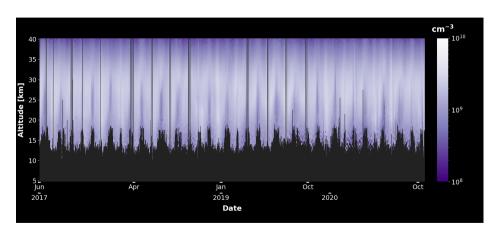
### Utilization of DMP in Data Products Charles Hill

### DMP Overview



## NO<sub>2</sub> Product With DMP Correction





### Utilization of DMP in Data Products

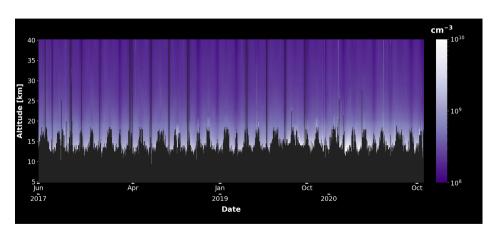
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DMP Overview



# NO<sub>2</sub> Uncertainty NO DMP Correction





# Utilization of DMP in Data Products Charles Hill

### DMP Overview

Where is it?

Daily Observations

#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol 1021 nm Aerosol

#### Species

O<sub>3</sub> **NO<sub>2</sub>** H<sub>2</sub>O

H<sub>2</sub>U Products Sum

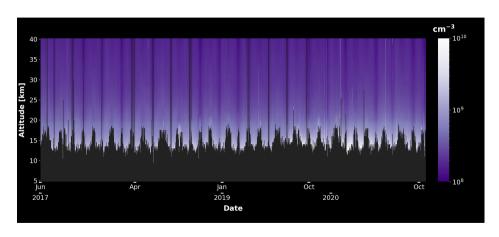
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# NO<sub>2</sub> Uncertainty With DMP Correction





### Utilization of DMP in Data Products

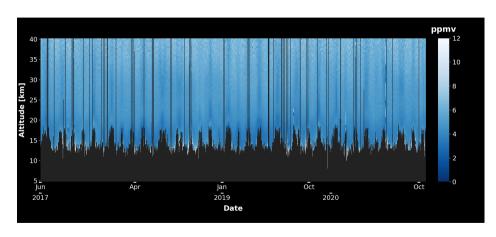
# Charles Hill

DMP Overview



## H<sub>2</sub>O Product NO DMP Correction





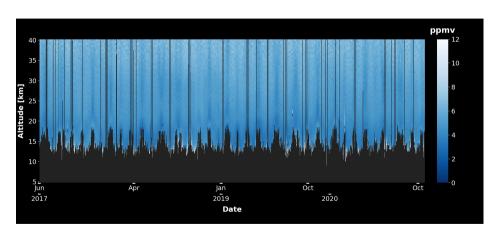
### Utilization of DMP in Data Products Charles Hill

## DMP Overview



## H<sub>2</sub>O Product With DMP Correction





Utilization of DMP in Data Products

# Charles Hill

### DMP Overview

What is it? Where is it?

How are we using i

#### Transmission

#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

#### Species

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H<sub>2</sub>O

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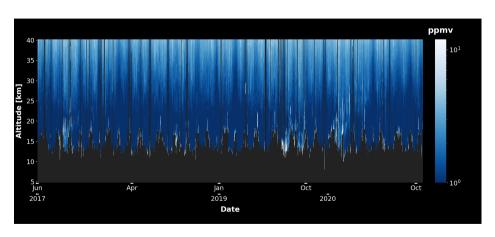
What is next

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# H<sub>2</sub>O Uncertainty NO DMP Correction





# Utilization of DMP in Data Products Charles Hill

### DMP Overview

Where is it?
Daily Observations

#### Transmission

### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

#### Species

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H<sub>2</sub>O

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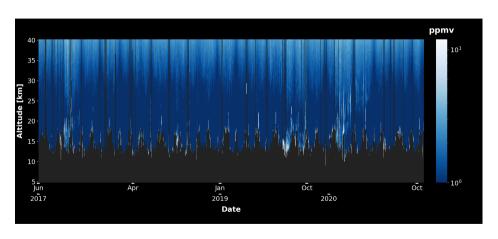
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# H<sub>2</sub>O Uncertainty With DMP Correction





Utilization of DMP in Data Products

Charles Hill

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DMP Overview
What is it?
Where is it?

Daily Observations

#### Transmission

#### Aerosol Products

384 nm Aerosol 676 nm Aerosol 756 nm Aerosol

#### Species

 $O_3$  $NO_2$ 

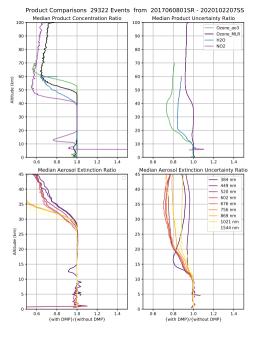
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What is next?

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### Utilization of DMP in Data Products

### Charles Hill

### DMP Overview

Products Summary



# **Disturbance Monitoring Package (DMP)**



### What is next for the DMP Team?

- Submit a paper with details about the DMP correction to the SAGE III product
- Release a DMP-corrected version of the SAGE III product
- Comparisons with ISS LVLH attitude quaternion time series to assess truss deflections
- Absolute attitude product
  - Improved latitude/longitude/altitude registration for limb scattering measurements by implementing the SAGE III attitude Kalman Filter
  - Payload vibration environment at ELC-4 beneficial to ISSP and external payload community



### Utilization of DMP in Data Products Charles Hill

## DMP Overview

What is next?



